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STUDIES OF PROTECTIVE CLOTHING FOR USE IN TWO-SIDED BR TRAINING--ETC(U)
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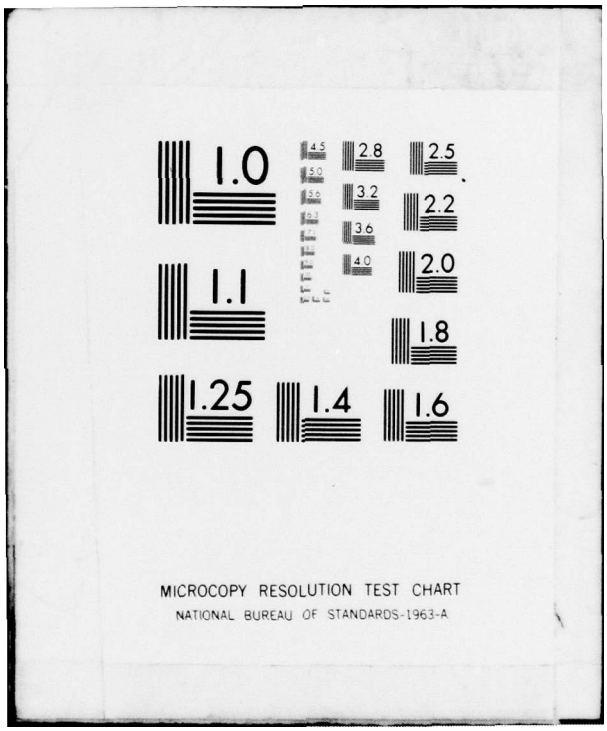
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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

(1) LEVEL II

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER

(6) 4. TITLE (and Subtitle)

STUDIES OF PROTECTIVE CLOTHING FOR USE IN TWO-SIDED BB TRAINING.

(9) 5. TYPE OF REPORT & PERIOD COVERED

Consulting Report.

6. PERFORMING ORG. REPORT NUMBER

(10) 7. AUTHOR(s)

C. E. George

(15) 8. CONTRACT OR GRANT NUMBER(s)

DA-44-188-ARO-2

9. PERFORMING ORGANIZATION NAME AND ADDRESS

Human Resources Research Organization (HumRRO)
300 N. Washington Street
Alexandria, Virginia 22314

(12) 10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS

28

11. CONTROLLING OFFICE NAME AND ADDRESS

Department of the Army
Office of the Chief of Research and Development
Washington, D.C. 20315

(11) 12. REPORT DATE

December 1965

13. NUMBER OF PAGES

26

14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)

15. SECURITY CLASS. (of this report)

Unclassified

15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

DDC RECEIVED FEB 8 1980 B

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

Research performed under Technical Advisory Services for the U. S. Army Infantry School, Fort Benning, GA.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Protective Clothing
BB Guns

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

~~Reports~~ CONCERNING THIS REPORT IS a rapid-response study for the Army Jungle Warfare School on the amount and type of protective clothing required for soldier protection when BB guns are used in two-sided, surprise-fire training exercises.

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Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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CONSULTING REPORT

Studies of Protective Clothing for Use in Two-Sided BB Training

by

C. E. George

December 1965

Approved:

T. O. JACOBS
Director of Research

HumRRO Division No. 4
(Infantry)
Fort Benning, Georgia

CONTENTS

STUDIES OF PROTECTIVE CLOTHING FOR USE IN TWO-SIDED BB TRAINING

BACKGROUND

A telephone request for research was received by the U. S. Army Infantry School from the Army Jungle Warfare School on the morning of 2 December 1965. The request was to determine protective clothing requirements for use with BB guns in two-sided surprise fire training exercises. Answers were wanted within approximately one week. Captain Charles E. Newbern of the Small Arms Committee, Weapons Department, was named Project Officer. Capt Newbern requested Technical Advisory Service aid from HumRRO Division No. 4 (Infantry) and met with representatives of the Division on the afternoon of 2 December.

During the meeting it was decided that kinds and amounts of protective clothing required would depend upon the specific kinds of guns to be used, the ranges to be involved, temperatures during training, mobility requirements, and cost factors. It was concluded from earlier Division experience with BB guns that gas operated guns would probably be less satisfactory than would spring operated guns. It was further decided that pump- or slide-action guns might be better than lever-action because the former can be activated while keeping the muzzle pointed down range.

PRELIMINARY GUN TESTS

Three different models of BB guns were tested in preliminary trials. The best for over-all handling, speed and ease of operation, and accuracy

was a slide-action model.[1] The gun will not, of course, take the kind of pounding a service rifle will take, but it is rugged enough for training use. One possible drawback with this gun is that it is relatively so powerful that there was some concern that an unlucky hit might chip a bone despite protective clothing, even though this would not be likely. It was decided to try a reduced-power version of the same model. Two guns of this model were modified by the Division Developmental Engineer.

Gun #1 was modified by removing the barrel, and the air plunger case and spring. A 0.040-inch hole was drilled just to the rear of the shot chamber in the bottom of the main barrel. Drilling burrs were polished out. The gun was then reassembled with the plunger spring anchor[2] replaced with the plunger spring compressed to a somewhat lesser extent than before disassembly. Gun #2 was modified in the same way except that the hole was not drilled and the plunger spring anchor was replaced with the plunger spring completely decompressed.

The two modifications resulted in approximately equal power reductions and both gave good shot groups. BB trajectory was quite high compared to the unmodified gun, as was expected, but shooters rapidly learned to adjust to this. As will be shown below, either modification allows shooting at closer

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[1]Model 26, Daisy Manufacturing Company, Rogers, Arkansas. Retail price about $17.50 in Columbus, Georgia.

[2]To remove, drive out from the bottom of barrel with small punch.

ranges and with less protective clothing than does the original. The gun may be fired at quite a rapid rate by holding the trigger back and moving the slide for each shot.

PRELIMINARY CLOTHING TESTS

Hand Protection

The Army issue glove with liner was tested and found wanting. Extreme pain was reported by those shot in the hand from ranges of 20 to 30 meters with the unmodified gun. Even though the rounds did not penetrate the glove, fear was expressed that small bones in the hand might be damaged. Other gloves also proved unsatisfactory until LaCrosse[1] gloves (Exhibit A) were tried. These are the gloves used in pugil-stick training by the Ranger Department and by Army Basic Training Centers. The back of the glove is heavily padded and it has a metal reinforced gauntlet to protect the wrist and lower arm. Other suitable gloves could probably be found, but this represents one good solution.

It is difficult to fire a BB gun while wearing this glove unless a slit is cut in the trigger-finger of the glove. The trigger guard could be cut off of the gun as an alternative, but the slitted glove is probably the better solution. The palm of the glove will not protect against a BB but the man will have his palms encircled around his own gun in any case.

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[1]Peck-Auer Model, Bacharach-Rasin, Baltimore, Maryland

Crotch Protection

Two kinds of protectors were tried out and both found satisfactory. The kind used in prize-fighting[1] actually gives more protection than needed and is bulkier and heavier than necessary. The protector developed by the Ranger Department for pugil-stick training (Exhibit B) is fully adequate, is lighter, and also gives added protection from shots coming from behind or below.

Knee and Elbow Protection

Ordinary knee and elbow guards used by basketball players are recommended. They not only guard the joints but, if placed between two layers of clothing as recommended below, hold the second layer away from the body. The major factor found in avoiding painful "stings" from BB strikes is loose clothing.

Head Protection

Eyes, ears, throat, and mouth protection were major areas of concern. Two helmets were devised and tested, both assembled onto the Army helmet liner. Eye protection from direct hits is absolutely assured by a one-fourth inch plexiglass window. A full-power gun will do no more than very slightly dent this material at any range from point-blank to 30 meters.

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[1]Everlast Sporting Goods Manufacturing Company, New York.

The better helmet (Exhibit C) consists of a welder's mask[1] bolted to a helmet liner. The eyepiece is quarter inch plexiglass bolted over a rectangular area (about 3 by 7-1/2 inches) cut out of the fibremetal front of the mask. Heavy tent canvas is stitched to the mask, and to the rear portion of the helmet liner. To be certain of safety, the canvas should be doubled. Just below the eyepiece is an air inlet made of one-eighth inch aluminum bored full of small holes. The inlet shown is not fully adequate. It is suggested that it be about six inches long, that two more be added adjacent to the ears (to improve hearing as well as ventilation) and that many additional small holes be drilled in the helmet liner. The plexiglass can be bent to conform to the curvature of the welder's mask by heating it to 350 to 375 degrees F. Care should be taken to avoid sharp bolt ends on the inside of the helmet so that the wearer's face won't get scratched when putting it on or taking it off. This helmet gives off a nice "ping" to inform the man that he has been hit.

The second helmet (Exhibit D) is also fairly satisfactory but it tends to interfere with spontaneous head movements. This helmet consists of doubled tent canvas about 18 inches long, stitched to the helmet liner. Two flat pieces of plexiglass are bolted in a V-shape to provide an eyepiece. Glasses can be worn under either helmet provided that the canvas is generously "bloused out" at the back.

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[1]Fibremetal Products Company, Chester, Pennsylvania

A third possibility, which was not tried because of insufficient time, would be to affix a fine mesh steel screen wire frame around the helmet liner with a plexiglass eyepiece. Ordinary iron, aluminum, or copper screen would not stop the BBs but there is said to be a strong steel mesh commercially available which would do the job.

Upper Trunk Protection

Two systems of protection were developed. System A consists of undershirt, fatigue jacket with elbow protectors, and a zippered and snapped field jacket overall. Both jacket collars are worn "up," to protect the neck. Jacket sleeves are buttoned and pushed well inside the gauntlets of the LaCrosse gloves. The fatigue jacket is worn tail out to increase clothing looseness. This system protects adequately from 15 meters out with the modified gun.

System B consists of undershirt, fatigue jacket, field jacket liner with elbow pads, and field jacket. This system protects adequately from ten meters out with the modified gun and, if some occasional "stinging" is acceptable, even with the full power gun, although a 15-meter limit would be preferable under full-power conditions.

Abdomen and Leg Protection

System A consists of underwear, fatigue pants (pants leg free from boot) with knee guards and crotch protector, and field pants (bottom of pants legs should be loose). The combat boot is worn, but foot shots should be avoided where possible to save the boot and rather considerable foot pain.

System B adds the field pants liner. Protection is the same as that given above for the comparable systems.

FULL SYSTEM TRIALS

Underlying Assumptions

What seems to be needed for the proposed training is a gun and a protective system that will let a man know when and where he is hit but will not do permanent damage to him or pain him so much that he will be too apprehensive to enter fully into the training. The protective system should also allow a high degree of movement and a fair degree of comfort.

The subjective experience of pain varies greatly among individuals. The subjects studied most intensively for this report have had fairly high pain tolerances, but findings and interpretations have been adjusted somewhat on the basis of responses from low tolerance subjects. If things are arranged so that every man feels most of the hits made on him, some men are going to experience real pain on a few occasions.

Stationary Trials

Following tests of individual protective items, men were dressed in System A gear (without liners) or System B gear (with liners) and the Exhibit C helmet. Shots were fired, with a modified gun, at ranges of 5 to 25 meters and at ranges of 10 to 30 meters with a full-power gun. An expert shot hit predesignated areas in order to systematically search for vulnerable spots. Subjects were taken under fire while facing the shooter, while facing away from

the shooter, and while standing sideways to him. It was possible to note the point of impact of virtually every round. These data were recorded along with the subject's report on how the blow felt. The scale of response was: "didn't know I was hit, could hear the hit but couldn't feel it, could feel the hit but it did not sting, could feel the sting but it wasn't too bad, it hurt more than training should hurt."

The general finding was that the greatest pain was reported from areas where the clothing happened to be taut against the skin. A hit on the foot, for example, was quite painful despite the thickness of combat boots. It is, of course, unlikely that people will be very often shot in the foot during this kind of training. It was impossible, in the long run, to pick out other spots which were consistently vulnerable. Much depended on the subject's stance and the fitting of the clothing on him. Strikes in the head area could be recognized only by sound since the helmet does not allow the BB to push the material against the skin. Men could tell that they were being hit, even from the 30 meter ranges, well over 90% of the time.

System A gear (minus liners) produced only a small, and quite tolerable, number of pain responses when fired on by the modified gun at 15 meters. Even at 10 meters only about half of the hits produced pain, and the degree of pain was considered to be tolerable so long as it did not occur with great frequency or over extended periods of time. Use of the full strength gun against this gear was judged to produce too much pain too often for training unless subjects were very highly motivated, had high pain

thresholds, and would not be hit more than once or twice during a given exercise. Even then, permissible ranges should be not less than 20 meters.

System B gear gives satisfactory protection against the modified gun at 10 meters or greater and against the full-strength gun at 20 meters. These figures can be halved without actual danger, but this is apt to produce a good deal of complaining and enough fear to detract from training value for some men.

Movement Trials

Men garbed in each system were fired on while running toward, walking toward, running lateral to, and walking lateral to the firer. When running toward the firer, the clothing tends to "blouse" out so much that the man may not know that he is hit unless the round "pings" on the helmet. Walking toward the firer gives excellent results, the subject feels the hit but is unlikely to experience pain. Walking or running laterally to the firer (across his front) will produce moderately painful hits from time to time since the movement will cause the clothing to bind or tighten over one body area or another.

Either system allows considerable freedom of movement but moving to or from prone positions is somewhat awkward. It is also difficult to see from the prone position, and the gun is likely to be broken if a man uses it in the normal way when "hitting the dirt." This problem might be circumvented by using the prone position only after the man has been hit. It would thus serve

as a signal to his opponent that he is out of action. Accurate firing, given a little practice, is not interfered with by the gear from hip, waist, or under-arm positions.

RECOMMENDATIONS

1. System A protective gear is recommended for use in tropical regions with the Exhibit C helmet modified for improved ventilation and hearing. Modified slide-action BB guns of the kind described are recommended for use with this protective gear. Training periods might have to be kept fairly short to avoid heat exhaustion on some days, but medical opinion would need to be obtained on this point.

2. Trainees should be instructed to fire at the head and trunk area (as they normally are) since these are the least vulnerable areas with this protective gear. They should also be instructed to fire between the ranges of 15 to 25 meters but the umpire need not stop the action until the men are approximately 10 meters apart. The prone position should be assumed only when the man has been hit, and this gently enough not to break the gun.

3. Trainees should be reminded to remove watches and other breakable items. Cardboard can be placed in pockets for additional protection if experience dictates the need for it.

4. Class X clothing should not be used unless tested. Clothing used in these tests was all serviceable, not new but in good, sound condition.

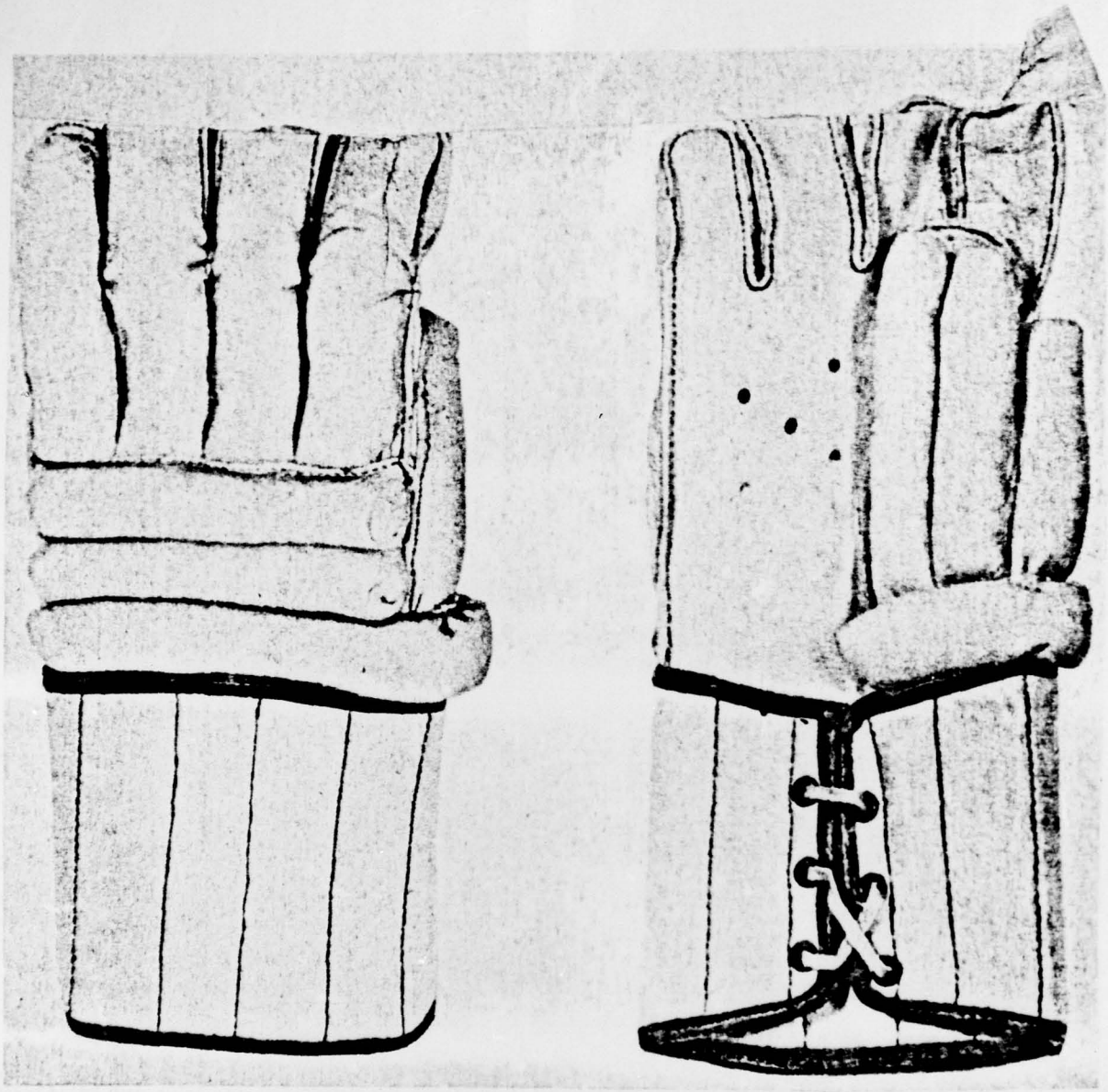


EXHIBIT A

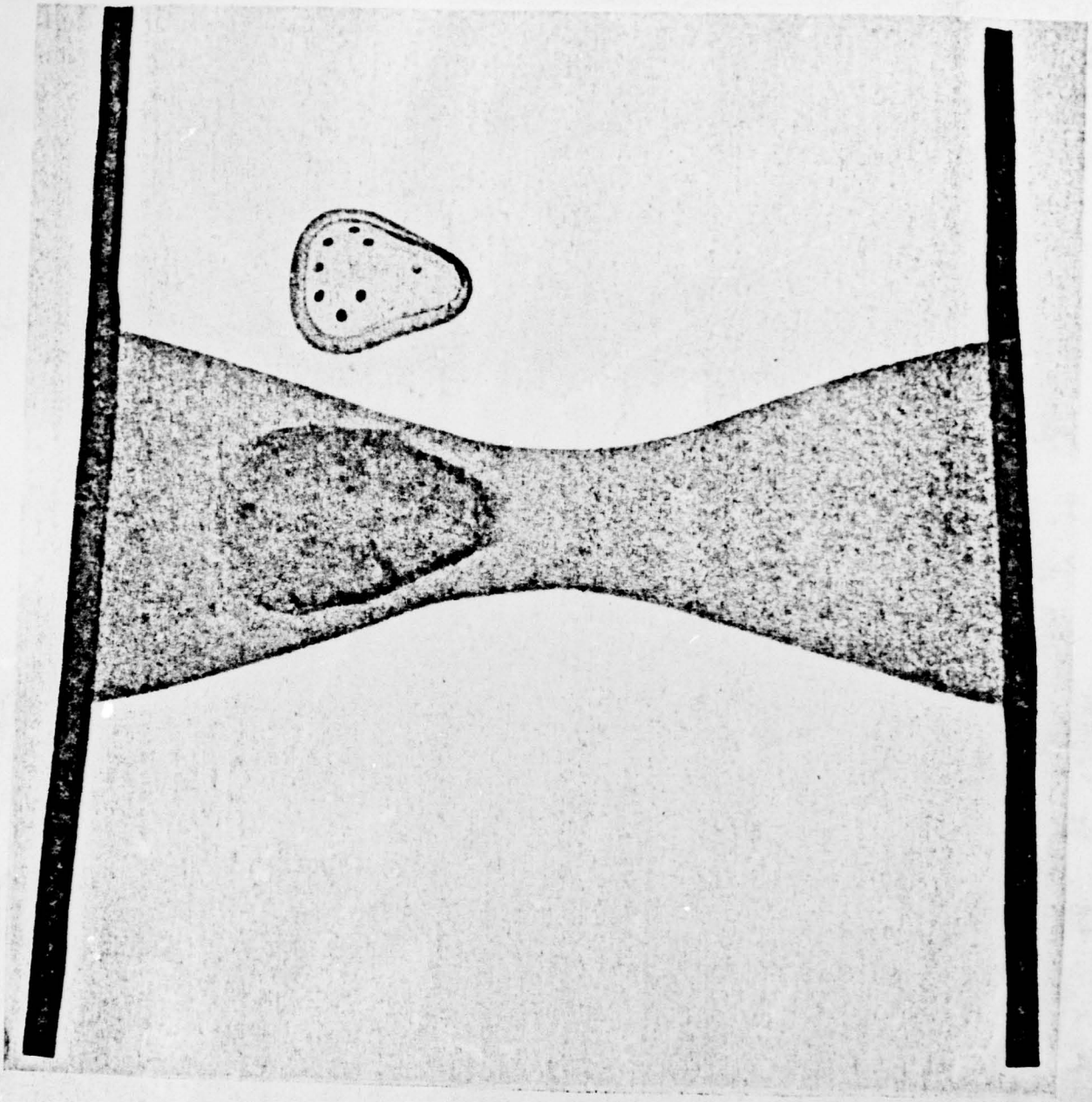


EXHIBIT B

EXHIBIT C

EXHIBIT C

EXHIBIT D

EXHIBIT D

TO REDUCE POWER OF DAISY MODEL 26 BB GUN

1. Remove screw on forward section, right side of receiver (large head).

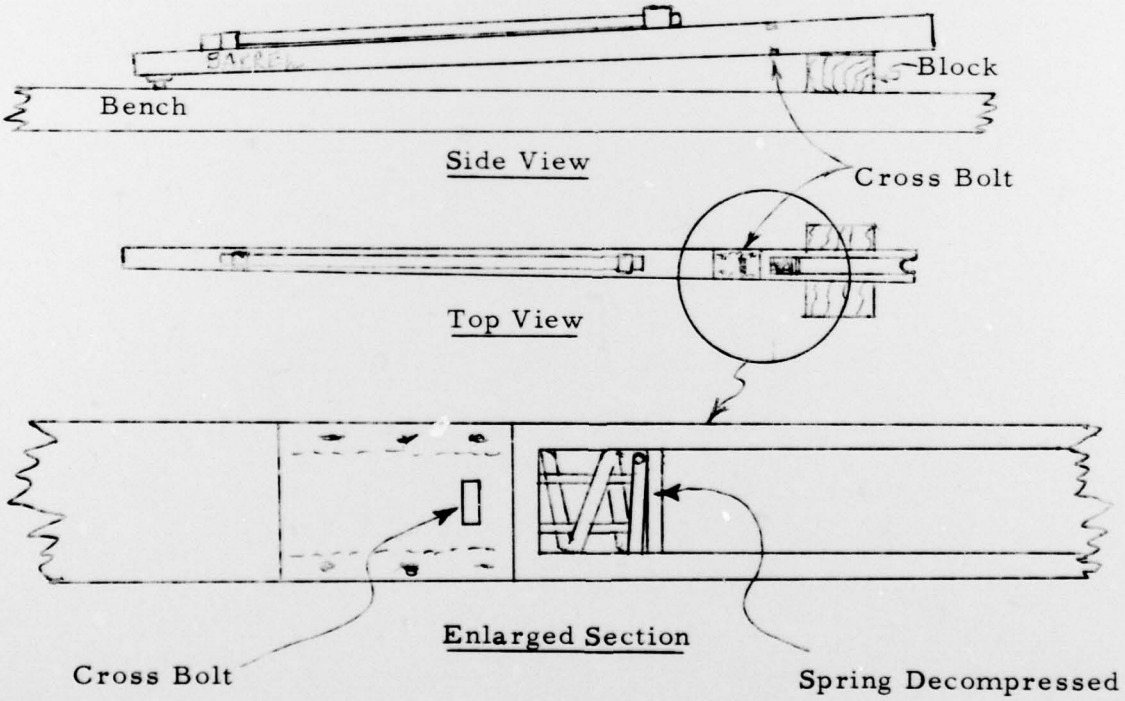
2. Pull barrel from receiver in forward direction; toward the end of separation, slightly raise the front of the barrel.

3. Place barrel with sights down on bench, with rear of barrel resting on a block of wood.

4. With a suitable nail or small punch, drive out the cross bolt (26-CB). After the cross bolt is halfway out, it may be removed with pliers. CAUTION: Remove slowly because of spring pressure. Do not point rear of barrel at anything the spring may damage.

5. With the spring decompressed, turn the barrel sights up and replace the cross bolt.

6. This reduces the power of the gun about one-third.



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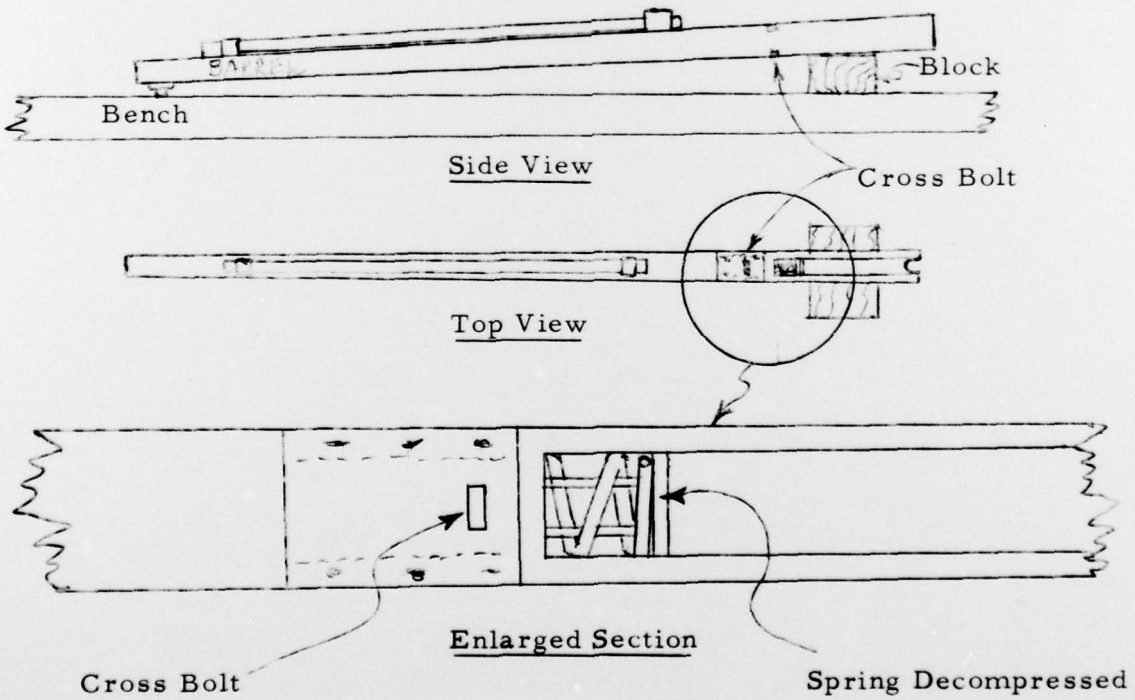

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ANNEX I

CONSULTING REPORT

Studies of Protective Clothing for Use
in Two-Sided BB Training

January 1966

ANNEX I

CONSULTING REPORT

Studies of Protective Clothing for Use
in Two-Sided BB Training

FURTHER INVESTIGATION AND TESTING OF HEAD PROTECTION

The headgear described in this annex was developed to provide the wearer with a more flexible piece of equipment that is (1) easy to breathe through in all types of weather, (2) moves easily with all head movements, (3) is transferable from one person to another with a minimum of adjustment, and (4) is made up of parts relatively easy to obtain from local sources.

A. CANVAS

The canvas used on this headgear is of the regular military type and is designated as DUCK Number 8, HTOD, Shade 7. This canvas, when new, is of sufficient strength to protect the wearer from BBs from both full power and modified guns at ranges from 5 to 30 meters. This canvas material fits over the standard Army helmet liner. Binding tape can be placed around the inside edges of the canvas to smooth out the raw edges.

B. EYE PROTECTION

Adequate eye protection is provided by a one-fourth inch plexiglass window (same as used in earlier models). This piece of plexiglass is approximately 3-1/2 inches by 7 inches. It is suggested that this be extended by approximately two inches to permit greater peripheral vision. There is some distortion in vision due to bending of the plexiglass but not enough to cause any real problems. Light aluminum stripping (.045) around the plexiglass is bolted through the plexiglass, the metal perforated breathing sheet and the canvas. Care should be exercised to ensure

that the heads of the bolts are on the inside of the helmet and the nuts are on the outside to protect the wearer from scratches or cuts on the face.

C. AIR INLET FOR BREATHING

The air inlet is made of cross perforated steel sheet metal 1/8-inch round and with a thickness of approximately 1/16 of one inch.[1] The diameter of the holes in this metal is .093 inches. The dimensions of this metal sheet are 2-3/4 inches by 7 inches. Various types of tape can be used around the edges of this metal to ensure that no cuts or scratches will bother the wearer. Additional ventilators can be added as necessary in tropical climates.

D. SECURING THE CANVAS OVER THE HELMET LINER

The regular Army issue camouflage band is used to secure the canvas firmly over the helmet liner and eliminate the "slipping" of the canvas around the liner when the head is moved. Care should be taken to ensure that this band is placed around the helmet liner only and not around the face or back part of the head of the individual.

E. MAINTAINING THE HEADGEAR SECURELY ON THE HEAD

There are two means of keeping the headgear firmly in place. The first is to use the regular chin strap properly adjusted. The second is to use the regulation Army camouflage band and place one under each arm and fasten it to the two loose flaps of the canvas on each side of the helmet. This second procedure is superior to the first, especially when considerable movement is necessary. These straps can be fastened to

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[1] J. M. Tull Metal and Supply Company, Inc., 285 Marietta Street, N.W., PO Box 4628, Atlanta 2, Georgia (also Greenville, Miami, Birmingham, Jacksonville, and Tampa)

the canvas flaps either permanently (bolted or sewed) or the end of each strap can be made adjustable. This adjustment can be similar to that used on the helmet liner chin strap. When different persons are to use the same helmet, it is advisable to make use of an adjustable strap to facilitate the transfer of this gear.

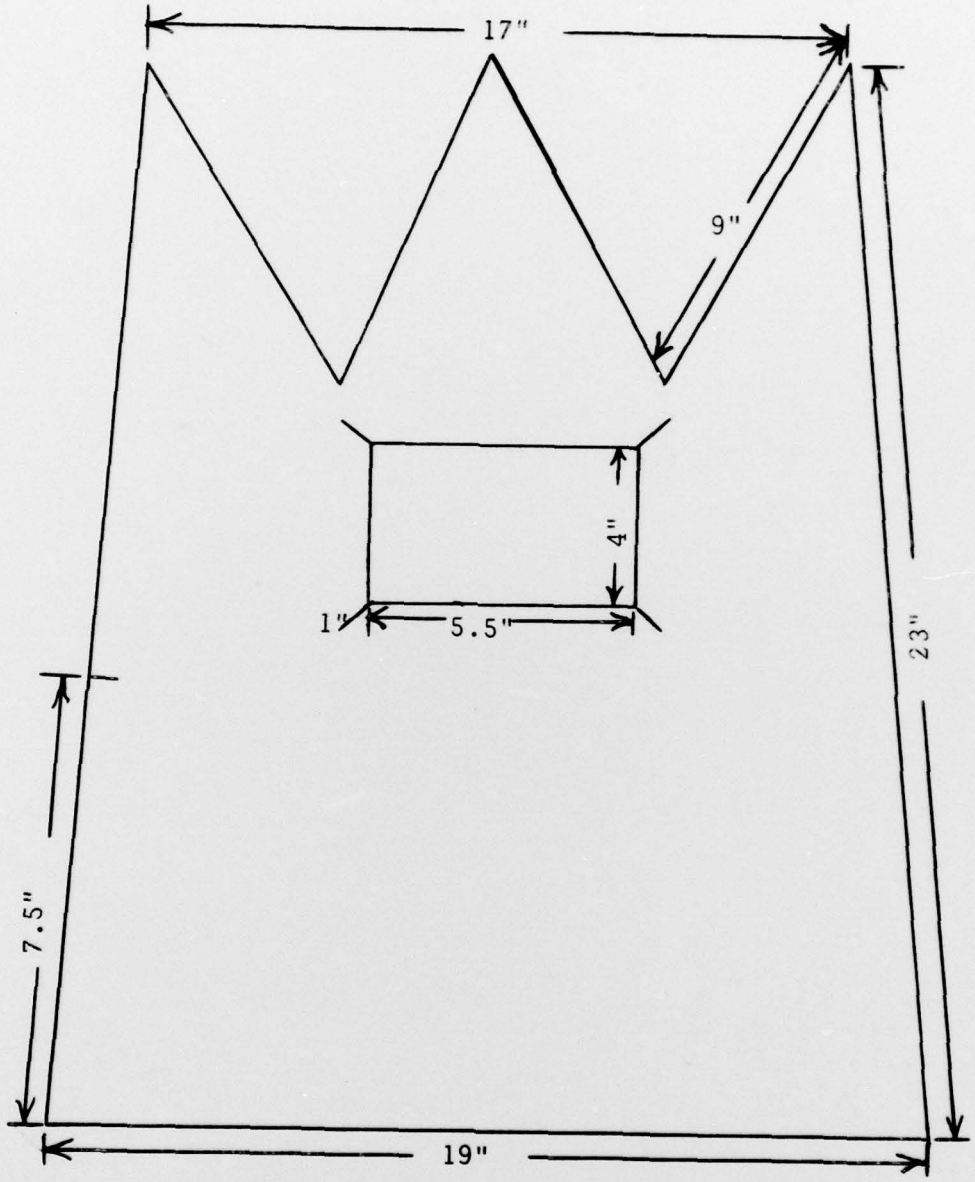
CONCLUSION

This headgear has been found to be superior to earlier models in many ways and is recommended for use in two-sided BB training.

EXHIBIT E

EXHIBIT F

EXHIBIT G



Pattern for Headgear Described in this Annex
Front and Back Same Except for Hole

1/2" Allowed on all Seams